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RESEARCH & DEVELOPMENT

PITTSBURGH COKE & CHEMICAL COMPANY

CONTRACT NO: DA-18-108-CML-5784 - P. O. NO: CP-5-10768

DA-18-108-CML-5785 - P. O. NO: CP-5-10768

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MONTHLY REPORT NO: 10

MARCH 1 - 31, 1956

DEVELOPMENT OF GAS-AEROSOL FILTER FABRICS

A. J. JUHOLA

and

C. E. SUNNERGREN

APRIL 1, 1956

JUN 5 1956

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DEVELOPMENT OF GAS-AEROSOL FILTER FABRIC

ABSTRACT:

Test runs have been made on the processing line showing satisfactory operations in some parts of the line and needed further development work and adjustments to other parts.

Several fabric runs have demonstrated that heavy fabric (formerly six-ply) can be made with four web plies.

The wet processed Code 106 glass purchased from C. H. Dexter and Son is very uniform, has good handling characteristics and is comparable in filtration efficiency to the dry processed glass used previously.

Further development work was done on the uniformity control device for Whetlerite feeder. A differential transformer was attached to the balance in place of the electrical contacts to sense the movement of the balance beam. Results show slight improvement in sensitivity of balance, but further testing is required before any final decision can be made as to the best method.

Several new water repellents were tested but none of them showed any superior qualities over the Dryette now in use.

Some changes were made in chute feeding the sifter; otherwise, grinding equipment performed according to expectation.

Work by plant labor was completed excepting for painting. This will be completed in April.

Oven warm-up time was found to be too long, 2-1/2 hours. Study is being made to correct this.

Design work on machinery coming after oven is in progress. Parts for the cooling conveyor are already ordered. Old machinery was installed here pending the construction of the new improved machinery.

A program for systematic maintenance and lubrication was established.

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I. TEST RUNS ON EXPANDED PROCESSING LINE:

In these runs several objectives were sought:

- A. Observe general behavior of newly installed machinery.
- B. Determine whether Type III B fabric can be made in four-ply instead of the six used previously.
- C. Test the wet processed fiber glass web for its filtering efficiency in the fabric.

A. Newly Installed Machinery - In Figure 1 are two layouts of the expanded processing line. Layout No. 1 shows the machinery in position for making backing layer and Layout No. 2 shows the machinery in position for making fabric. As indicated in layouts, the relocating of the machinery is done by way of the light-weight tracks. There are now two web forming lines, No. 1 and No. 2, making it possible to make a four web ply fabric by continuous operation. The new oven is located in position as shown. Design work has started on machinery following the oven; those shown in layout are old machinery connected temporarily until new machinery is installed.

The web forming lines and the calender press - water repellent unit are operated from the central control station as shown in layouts. The conveyor drives of Line 1, Conveyor D and the calender press - water repellent unit are operated on DC current obtained from the motor-generator and electronic rectifier units located in the warehouse. The oven and ultimately the units following the oven are operated from the control panel as shown in layout.

The 50 x 150 mesh Whetlerite, coming by elevator from the grinding room, (See details in Figure 1 of Monthly Report No. 6) is taken by conveyor to distribution station over blending conveyor of Line 2. Here it is distributed as required to bin of Line 2 and/or to conveyor leading to bin of Line 1. This conveying system is designed to deliver the Whetlerite in level layer into bins to minimize segregation of mesh size fractions and to automatically maintain Whetlerite level in each bin between 29 and 35 inches from the bottom opening of the bin. Installation of several components of the system have not yet been completed; hence, the effectiveness of this system on feeder uniformity has not been determined.

Both Whetlerite feeders have been operated. The five-inch wide gates on the feeders have made uniformity adjustments quicker but uniformity was found to be about the same as before plant shut down. Bins were filled by bucket to make these runs.

The web made with the new Rando-Webber on Line 2 was of finer texture, stronger, and generally of better quality than that made with the old Rando Webber on Line 1. This difference in quality is attributed to the new sharper lickerein and greater blower capacity of the new Rando-Webber. A new lickerein has been ordered for the old Rando-Webber and an increase in blower capacity is contemplated. Because of the greater blower capacity, it has also been found that the Whetlerite collector and air washer are unnecessary accessories on the new Rando-Webber; the Whetlerite and fiber dust remain suspended in the air stream are recycled to the web.

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The pad forming and blending conveyors have functioned satisfactorily.

Some improvement work is required on the transfer of web from Conveyor A to B. A triangular aluminum guide coated with Teflon, (See Type A in Figure 2 of Monthly Report No. 1) is being used but core web stretches and tears while passing over this type guide. Type B transfer method (See above-mentioned report) was incorporated into Conveyor B and has functioned satisfactorily. Some changes were required in the original design. Instead of using the rolls at the 45 degree angle as shown, non-rotating tubes were used.

Short pad runs through the oven did not seal properly. Considerable leakage of heating air around the edges of the pad were observed and blower capacity was too low. Both of these conditions are being corrected.

The Teflon coating on the oven belt has so far completely eliminated sticking of backing layer to belts, making use of nylon marquisette cover sheets unnecessary. The Teflon coating, however, abrades very easily, hence precaution must be exercised in operating oven.

- B. Four Web Ply Fabric - Several runs were made on each web forming line to determine whether Type III B, previously made with 6 web plies, could be made with four web plies. Since the oven was not in condition to properly heat seal, the laboratory platens were used for this purpose. Samples 5 x 5 inches square were made.

In Table I are test results on Type III-B fabric made with four and six web plies. The procedure of preparation in each case was the same as much as possible. For the four web ply fabric, however, the webs were heavier. These runs were made on Line 2 with the new Rando-Webber and using the Rando-Feeder.

The results show no significant difference in properties of these two materials. The six-ply fabric may be expected to be more uniform but sufficient samples were not prepared to check this.

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TABLE I

TEST RESULTS ON FABRIC PREPARED FROM FOUR AND SIX WEB PLIES

<u>Run No.</u>	<u>No. of Webs</u>	<u>*Pressure Drop, mm. of Water</u>	<u>*DOP Pene., percent</u>	<u>Whetlerite, gm./100 sq. cm.</u>	<u>Thickness, mm.</u>	<u>Alpha</u>
A	6	64	0.015	17.2	7.2	6.0
B	6	49	0.062	17.2	7.6	6.5
C	6	<u>55</u>	<u>0.050</u>	<u>17.0</u>	<u>7.6</u>	<u>6.0</u>
	Averages	56	0.042	17.2	7.5	6.2
3-21-56-2	4	54	0.017	15.9	6.5	6.6
3-29-56-1	4	<u>64</u>	<u>0.011</u>	<u>16.5</u>	<u>6.7</u>	<u>6.2</u>
	Averages	59	0.014	16.5	6.6	6.4
Specifications		50 max.	0.07 max.	15.6	6.8 max.	

*Test run at 32 liters/min. flow rate

- C. Wet Processed Glass - In a previous monthly report (Monthly Report No. 5) test results were given showing very poor uniformities of some of the Code 106 fiber glass webs. These non-uniformities were due to the adjacent web plies sticking to each other on the rolls and then during unrolling would delaminate forming thick and thin areas. Some of the rolls could not be unrolled at all.

As a remedy for this situation L.O.F. Glass Fibers Company offered a wet processed glass which, on laboratory test, showed excellent uniformity and unrolling characteristics. It was also comparable to the dry processed glass in its filtration characteristics. L.O.F. Glass Fibers Company, however, did not wish to go into the production of this web; it is now obtained from C. H. Dexter & Sons, Inc., Windsor Locks, Connecticut. About 6 pounds each of a 30 gm. and 10 gm. per sq. yd. web were obtained and tested.

In Table II are test results given comparison of properties of Type III B fabric prepared with both type fiber glass. These fabrics were made on Line No. 2 using four web plies.

The results show comparable performance characteristics but more wet glass is required. About 0.130 pounds of web glass is required per sq. yd. of feed as compared to 0.085 pounds of dry glass.

TABLE II

TEST RESULTS ON FABRIC PREPARED WITH DRY AND WET PROCESSED FIBER GLASS

<u>Run No.</u>	<u>Type Glass</u>	<u>Am't Glass in Feed lbs./sq. yd.</u>	<u>Pressure Drop, mm. of Water</u>	<u>DOP Pene., percent</u>	<u>Whet., gm./100 sq. cm.</u>	<u>Thickness, mm.</u>	<u>Alpha</u>
3-21-56-2	dry	0.084	55	0.025	15.8	6.5	6.6
3-29-56-1	dry	0.087	64	0.011	17.2	6.7	6.2
3-30-56-1	wet	0.130	60	0.03	16.5	6.3	5.8

II. EXPERIMENTAL:

- A. Uniformity Control Devices for Whetlerite Feeder - The differential transformer, Schwitz Model 0335-1, and the displacement controller, Daytronic Model 332, that had been on order were received during the latter part of the month. The differential transformer was attached to the balance beam as shown in schematic drawing in Figure 2. Movement of the iron core causes phase change and voltage variation in the current from the secondary winding of the transformer. These variations are picked up by the displacement controller to regulate the movement of the gate on Syntron feeder. The differential transformer replaces the electrical contacts shown in Figure 1 of Monthly Report No. 7. It was hoped that the transformer would give greater sensitivity to the balance and also decrease chattering of the relays.

The test results are summarized in Table III. In the first experiment, no controlling device was used and voltage to Syntron was kept constant. The mean weight deviation was 1.24%. This is an unusually uniform constant feed rate, possible because of the ideal laboratory conditions, but which do not occur in the pilot plant. In Experiment 4, the transformer was used but with constant voltage applied to Syntron feeder. The mean weight deviation was not as good. A similar decrease in rate uniformity has been observed with the electrical contacts. In experiments 2, 3, 5 and 6, the voltage to the Syntron feeder was varied according to a predetermined time schedule to simulate type of feed rate variation that may occur in pilot plant feeders. When controller was off, Experiment 3, the mean weight deviation was 23.6%. When using the electrical contacts the mean weight deviation was 3.0% and when using the transformer the mean weight deviations were 2.8 and 2.1 on two separate experiments. The limit contacts on the displacement controller were set to the upper limit of sensitivity. In Experiment 6, a smaller iron core was used in the transformer as an attempt to increase sensitivity of balance.

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TABLE III

TEST RESULTS ON FEED RATE UNIFORMITY CONTROL UNIT

<u>Experiment No.</u>	<u>Type Controller</u>	<u>Position of Controller</u>	<u>Voltage to Syntro</u>	<u>Feed Rate, lbs./hr.</u>	<u>Mean Wt. Deviation, percent</u>
1	electrical contacts	off	constant	5.33	1.2
2	electrical contacts	on	varied	5.58	3.0
3	electrical contacts	off	varied	5.83	23.6
4	transformer	on	constant	5.64	2.3
5	transformer	on	varied	5.23	2.8
6	transformer	on	varied	6.43	2.1

Further experiments are required to determine whether these observed differences in mean weight deviation are real. The transformer gave much smoother operation but is also a considerably more expensive piece of apparatus. The behavior of the unit suggested that even more damping of the balance beam is required. A magnetic damper has been ordered for attachment to the beam near the transformer.

- B. Water Repellents - The testing of new water repellents started last month was continued. The objectives are to find one that will deposit less inflammable waxy solids in the oven and release less smoke and irritating vapors during curing than the Dryette repellent being used at the present time. Quadrapel R, manufactured by Rumford Chemical Works, Rumford, Rhode Island, tested last month had some of these desired characteristics and for further testing in the pilot plant, 5 gallons of it have been ordered.

In the following table are listed the type and vendor of repellents tested this month. Dryette is used as standard of comparison.

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TABLE IV
WATER REPELLENTS

<u>Repellent</u>	<u>Type</u>	<u>Manufacturer or Vendor</u>
Dryette	non-durable wax base	Cravanette Company Hoboken, New Jersey
Perma-Par W	permanent silicone resin emulsion	Refined Products Corporation Lyndhurst, New Jersey
Perma-Spray ND	non-durable, appears to be wax base	Refined Products Corporation Lyndhurst, New Jersey
Drusil W	durable silicone emulsion	E. F. Drew and Company, Inc. Boonton, New Jersey
Drusil 30	durable silicone emulsion	E. F. Drew and Company, Inc. Boonton, New Jersey
Decetex 104 (This one has been tested before)	durable silicone emulsion	Dow Corning Corporation Midland, Michigan
Luposec	wax aluminum salt emulsion	Jacques Wolf and Company Passiac, New Jersey

All water repellents were prepared in 13% solution (emulsion) with lukewarm tap water. Backing layer sample soaked for 1 to 1-1/2 minutes, pressed to remove excess solution and dried and cured for 2 minutes at 150°C. The backing layer used on these tests was made from a blend of Vinyon and viscose rayon. Water repellency test results are given in the following table.

TABLE V
WATER REPELLENCY

<u>Repellent</u>	<u>Repellency, inches of water</u>
Dryette	10.3
Perma-Par W	5.2
Perma-Spray ND	7.1
Drusil W	6.8
Drusil 30	5.9
Decetex 104	8.3
Luposec	9.0

None of the new repellents equalled Dryette on repellency nor offered any other special advantages.

III. PILOT PLANT EXPANSION:

A. Layout, Design and Construction:

1. Grinding Room:

Operation of the grinding room showed one weak link. The 6-inch O.D. chute feeding from an elevator to the sifter would not satisfactorily feed Whetlerite. The chute has been inclined at 32° and fitted with a Syntron magnetic vibrator to help the Whetlerite flow. The sifter and elevator have been rearranged and the chute redesigned to permit a 45° slope and retain the Syntron vibrator.

The remaining equipment performs according to expectation.

2. Fabric Processing Line:

a. Equipment Installation and Assembly:

The plant labor force finished their work, except for painting during the month. Painting will continue into April.

Line 1 and Line 2, using the DC and AC equipment, have been completely installed, wired and put into operation.

The instrumentation and insulation of the oven were completed and several test runs were made. These runs show that approximately 2-1/2 hours are required to bring the oven from room temperature to 350°F. This is longer than desired and studies are being made by the oven fabricator and the project personnel to reduce the warm-up time.

The calender rolls, cooling conveyor, cut-off machine and take-away conveyor were replaced in their original order after the oven.

The Whetlerite conveying system is lacking a distribution "Y" duct and connecting duct to connect the conveying system to the bins. Until these are fabricated and installed, the bins are being filled by bucket.

Quotations have been received for safety guards on all the equipment where belts, sheaves, chains or sprockets are a hazard.

b. New Equipment Design:

Preliminary design work has been completed on the cooling conveyor and the necessary parts ordered.

c. Maintenance:

A maintenance program has been established that will permit planned inspection and lubrication.

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A record will be kept of all inspections, lubrications and repairs so that a preventive maintenance program can be established. A visible card file system has been ordered for the records.

Operating time totalizers will be wired into the starting circuits of each Rando Webber, the oven, calender and padder and the grinding room. Operating time will be valuable for the preventive maintenance program so that lubrication and repairs can be scheduled.

d. Drawings Completed:

1. Line No. 1 Whetlerite Bin Hood.
2. Line No. 2 Whetlerite Bin Hood.
3. Whetlerite chutes Line No. 1 and 2.
4. Perforated Cooling Conveyor Bed.
5. "Anglgear" Mounting Bracket.
6. Wireway Protector Layout.
7. Wireway Protector.
8. Generator Mount Assembly.
9. HYCC Motor Support Plate.
10. Whetlerite Uniformity Control Gate Drive and Syntron Liner Assembly.
11. "Y" Duct Carbon Divider.
12. Cooling Conveyor Layout.

B. Major Items Ordered:

1. U. S. Varidrive Motor Mechanical Remote Control - U. S. Motors Company
2. Compact Vacuum Cleaner - Compact Sales Service Company
3. Time Totalizers - R. W. Cramer Company
4. Dodge Taper Lock Steel Conveyor Pulleys - Somers, Fittler & Todd Company
5. Take Ups and Pilot Blocks - Link Belt Company
6. Balanced Spiral Drive Wissco Metal Conveyor Belt - Wickwire Spencer Steel Division
7. Foxboro Beta Roy Basis Weight Recorder - Foxboro Company
8. Reeves Extended Handwheel Control - Reeves Pulley Company
9. Lubricants - Pittsburgh Gage & Supply Company
10. Card Index System - Acme Visible Records
11. Marinite Insulation No. 36, 1 sheet - Voegele Company W.P.

C. Major Items Received:

1. Differential Transformer - Daytronic Corporation
2. Displacement Controller - Daytronic Corporation
3. Whetlerite Uniformity Control Gates - Ambridge Tool & Machine Company
4. Slotted Liner - Syntron Carbon Feeder - Ambridge Tool & Machine Company
5. Paint - Pittsburgh Plate Glass Company
6. U. S. Varidrive Motor Remote Control Unit
7. Dial Thermostats
8. Lubricants - Pittsburgh Gage & Supply Company

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D. Installation Period:

Painting of all the equipment and the interior walls and floor of the building will be complete early in April.

The Rando Webbers, Syntron Feeders, Conveyors and Oven have been installed and can be operated as soon as the painters are finished. Equipment operation to date has been on a limited scale due to the presence of the painters.

Debugging or correcting of difficulties that crop up should be completed in April.

IV. DEGREE OF COMPLETION OF WORK:

- A. Contract DA-18-108-CML-5784 - Total expenditures to March 31, were \$121,655.31 or 43% of the \$282,481.94 ceiling price. Fifty percent of the contract period has elapsed.

Phase III and IV work (see Monthly Report No. 8) is underway and some Phase V has started. Phase VI will start in May.

- B. Contract DA-18-108-CML-5785 - Total expenditures to March 31, were \$85,792.71 or 71% of the \$120,600 ceiling price. Purchases of machinery for Phase II work almost completed although installation work still is proceeding. Considerable purchase of equipment and machinery already made for Phase IV.

E. O. Ohsol
Director of Research and Development

Arvo Juhola
Arvo Juhola
Project Supervisor

C. E. Sunnergren
Assistant Project Supervisor

Va. A. Sukenik
Processing Engineer

Lester H. Harrison
Mechanical Development Technician

David Chalmers
Laboratory Technician

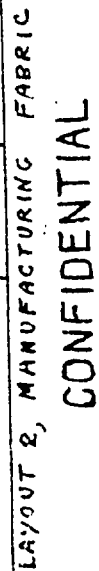
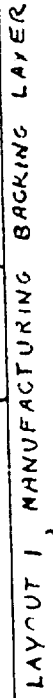
Samuel Wernert
Donald Mansmann
John Gargotta
Robert Martin
Roger Schmidt
Test Technicians

Ja

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LAYOUT OF PROCESSING LINE

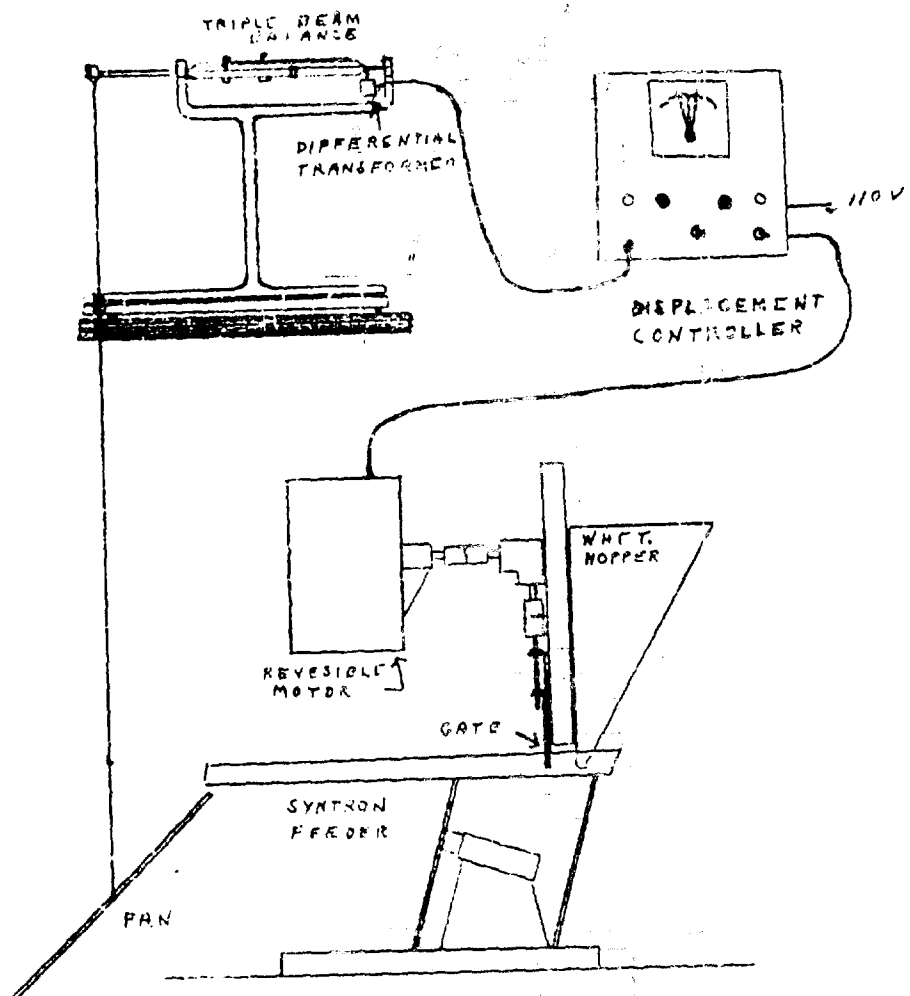


SCALE $V_{10} = 1.0$

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FIGURE 2

LABORATORY UNIT, UNIFORMITY CONTROL FOR
WHETLERITE FEEDER



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